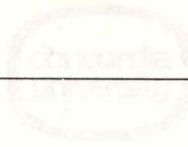


# Science



Sir George Williams  
Faculty of Science

## Geology





Geology is the study and understanding of the earth and its relationship to man. This involves the study of continents, the processes that cause the movement of continents, the creation of landscapes and earthquakes, the formation and destruction of the ocean floor, the site selection of roads and powerplants, the search for metals and fuels, the study of the ocean floors and mountain heights. The list is infinite - all this and more is geology.

There is now a new chapter opening in man's evolution, that of planetary science, and here too, the emphasis is primarily geological. However, fascination as the heavenly bodies may be, man's main interest is to make good and wise use of the resources, man has to study and understand the earth. Geology is the study of the earth.

#### GEOLOGY AS RELATED TO OTHER DISCIPLINES COURSE GUIDE

Because the scope is so comprehensive, geology is inter-related with most other pure and applied sciences. Physics, chemistry, mathematics, engineering, all are to some degree connected with the geological sciences. Geology together with geography, biology, soils, forestry, environmental sciences, meteorology and others is also part of the earth and life sciences.

Interdisciplinary programmes can be arranged to suit the particular interests of the student.

#### HOW DOES ONE BECOME A GEOLOGIST?

To become a geologist, the student should follow the pre-science curriculum at the collegiate level. However, geology courses at the university level can also be taken for credit by non-science students interested in the subject.

This course guide has been prepared months in advance of the 1976-77 academic year and information contained herein is subject to change. For further information concerning admission requirements, financial assistance, either government bursaries, explorations, or otherwise, Students are advised not to purchase any texts before consulting the department or professor concerned. Admissions bursaries, loans, stipends, and interviews are arranged with employers on campus.



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### WHAT IS GEOLOGY?

Geology is the study and understanding of the earth and its relationship to man. Knowledge of minerals and rocks...., the processes that shape the earth's surface...., rifting of continents ...., the prediction of landslides and earthquakes...., soil formation and erosion...., the use and conservation of water...., the site selection of roads and buildings...., the search for metals and fuels...., the study of the ocean floors and mountain heights...., the list is infinite - all this and more is geology....

There is now a new chapter opening in man's evolution, that of planetary science, and here too, the approach is primarily geological. However, as fascinating as the heavenly bodies may be, earth is still man's habitat. To make good and wise use of its resources, man has to study and understand the earth. Geology is the study of the earth.

### GEOLOGY AS RELATED TO OTHER DISCIPLINES

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To be a professional, the future geologist will follow a 3-year programme consisting of selected geology courses and electives. During the summer the student is encouraged to work in the field as geological assistant with either government surveys, exploration, or engineering companies. The Department considers it essential that the student spends one or two summers in field work before graduation. Advice is given as to job opportunities, and interviews are arranged with employers on campus.

### WHAT DOES A GEOLOGIST DO?

The field of geological sciences is so broad and the possibilities of employment so varied that it is impossible to list all the existing openings. A geologist can find employment with the government (including the United Nations, and U.N.-sponsored agencies), or with private companies, as a teacher, or become a consultant and work privately.

Following are some career profiles:

- checking the stability of areas prone to landslides or earthquakes
- surveying on mule-back or helicopter the economic possibilities of a mountainous area in Australia or South-America
- analyzing earth materials for composition, age, strength, physico-chemical properties, etc...
- deciding if and where subsurface mining should be extended
- teaching in school or university with possibilities of research grants
- selecting a dam site and evaluating its effectiveness keeping the ecological factor in mind.
- as a member of a crew of scientists charting the ocean floor, while studying the rate of deposition, heat flow etc.
- prospecting for mineral deposits in remote areas, using geophysical and geochemical exploration methods, and deciding where to drill
- exploring at a regional scale the still unmapped, rough coasts of Greenland
- investigating for purposes of irrigation the water resources of an arid region.
- interpreting by means of aerial photographs the geology of vast, inaccessible regions
- carrying out a seismic survey for oil exploration under the desert sun.

### FACULTY AND THEIR FIELDS OF INTEREST

#### Associate Professor and Chairman of the Department:

Henry S. de Romer, Ph.D. (McGill) - Structural Geology and Photogeology

#### Associate Professor:

Andre N. Deland, Ph.D. (Yale) - Mineralogy and Petrology

#### Associate Professor:

Stephen Kumarapeli, Ph.D. (McGill) - Geophysics, Geochemistry and Economic Geology.

The faculty has done geological work in Canada, the Alps, Ceylon and in South America. In Canada, research projects have been carried out in Ontario, St. Lawrence Lowlands, Gaspé, Northern Quebec and Eastern Townships. Currently, the faculty is involved in the Quebec Appalachians and the Canadian Shield.

### FACILITIES OF THE DEPARTMENT

Adequate collections of minerals, rocks, thin sections, fossils, maps and air photos as well as the instruments and equipment necessary to study them are available to students.

The Department also uses facilities not located within its own laboratories. These include x-ray equipment and laboratories for Geochemistry and Geophysics.

For information about the Department contact Dr. H. S. de Romer, Chairman of the Department, Department of Geological Sciences, McGill University, 3480 McTavish Street, Montreal, Quebec H3A 2T8, Canada. Tel: 393-4450.

Dr. H. S. de Romer,  
Department of Geological Sciences,  
McGill University, 3480 McTavish Street,  
Montreal, Quebec, H3A 2T8  
Tel: 393-4450

### PROGRAMMES AND COURSES OFFERED

The Department offers three programmes reflecting different levels of concentration in geology, - specialization, major, and minor. Out of the 90 credits necessary for the B.Sc., and normally taken over a 3-year period, the "specialization in geology" programme specifies 63 required credits; 36 specific credits for the major; the minor requires 24 geology credits. For students interested in combining geology with other disciplines, such as biology or geography, joint programmes are available.

The following courses in an approved sequence constitute a Specialization in Geology:

I Year	II Year	III Year
Mineralogy I (3 crs)	Optical Mineralogy (3 crs)	Igneous and Metamorphic Petrology (3 crs)
Paleontology (3 crs)	Photogeology (3 crs)	Economic Geology (3 crs)
Physics of the Earth (3 crs)	Petrology (6 crs)	Mineral Deposits (3 crs)
Structural Geology (3 crs)	Mineralogy II (3 crs)	Stratigraphy (3 crs)
Exploration Geology (3 crs)	Tectonics (3 crs)	
	Field Geology (3 crs)	
in addition: 6 credits elective from: Analytical Methods in Geochemistry, Physical Chemistry, Statistical Treatment of Chemical Data, Computer Science or Biostatistics	in addition: 3 elective credits in geology	in addition: 3 elective credits in geology

The following courses in an approved sequence constitute a major in Geology:

I Year	II Year	III Year
Introductory Geol. (3 crs)	Structural Geology (3 crs)	Paleontology (3 crs)
Historical Geol. (3 crs)	Petrology (6 crs)	
Mineralogy I (3 crs)		

in addition: 15 elective credits from Geology

The following courses in an approved sequence constitute a minor in Geology:

Introductory Geology (3 crs)  
Historical Geology (3 crs)

in addition: 18 elective credits from Geology

Other electives in Geology are Sedimentary Petrology, Exploration Geochemistry, Exploration Geophysics, Engineering Geology, Geology of Canada and X-ray Crystallography.

The "specialization in geology" programme is designed to prepare students for both graduate studies and immediate employment. Its general orientation is towards applied and exploration geology.

An evening course in applied geology designed for the would-be prospector and rock hound is programmed for the fall and possibly winter terms.

Field trips to areas of geological interest form part of almost every course. Two field schools (1st-and 2nd-year levels) provide valuable practical experience and contribute to the training of a professional. The student is strongly advised to spend 1 or 2 summers with the government or exploration companies before graduation.

The small size of the Department ensures an informal and personal relationship between faculty and students.

### GEOLOGY CLUB

Students run an active geology club, arranging guest speakers, field trips, as well as social events. Their exhibits during science week have often been awarded the first prize.

### INFORMATION

for information about geology or the Geology Department contact:

H.S. de Romer, Chairman,  
Department of Geology,  
Concordia University, SGW-Campus,  
1455 de Maisonneuve Blvd. W.,  
Montreal, Quebec, H3G 1M8

Tel: 879-4459

GEOLOGY N-215  
INTRODUCTORY GEOLOGY (3 credits)

Professors: H.S. de Romer (Eve)  
S. Kumarapeli (Day)

Description: An elementary study of minerals and rocks, and of the internal and external processes which shape the earth's surface. Laboratory work deals with identification of minerals, rocks and fossils, as well as interpretation of topographic and geologic maps. Field trips to Mt. Royal, Eastern Townships and Laurentians. Lectures and laboratory.

Note: Students who have credits for Geology N-211, 211, N213 or 213, or CEGEP 901 or equivalent may not take this course for credit.

Texts: T.B.A.

Assignments & Grading: 50% class test and final exam  
40% lab assignments and lab tests  
10% field trips or projects

Prerequisite: None

Comments: With no prerequisites required, this course is open also to non-science students.

**GEOLOGY N217**  
**PHYSICS OF THE EARTH (3 credits)**

Professor: S. Kumara peli

Description: This course is directed toward the general understanding of physical phenomena of the solid earth. Subjects for consideration include the following: earth's origin, age, radioactivity, magnetism, gravity field, seismology, heat flow, structure, and physical state of the earth's interior, theory of sea-floor spreading, theories of mountain formation. Lectures and Laboratory.

Text: T.B.A

## Assignments T.B.A

### & Grading:

Prerequisites: CEGEP Physics 301; CEGEP Math 103, 203 or equivalent, Geology N215.

GEOLOGY N-231 (221)  
MINERALOGY I (3 credits)

Professor: A.N. Deland

Description: The study of the physical properties of minerals; their chemical properties; descriptive and determinative mineralogy; crystallography; various classes of symmetry. A few field trips near Montreal. Lectures and laboratory.

Note: Students who have credits for Geology 021 or equivalent may not take this course for credits.

Text: "Dana's Manual of Mineralogy" by Hurlbut, C.S., Wiley, 18th edition (1972) is the required text although there are many other good textbooks. A paperback pocketbook may prove very useful.

Assignments & Grading: 50% lab assignments and lab tests  
50% class tests, assigned problems and final exam

Prerequisite: No other university level course is required. CEGEP courses in Physics, Chemistry and Mathematics are required.

Comments: In the lecture periods, the emphasis will be on crystallography and crystal projection. In the laboratories, the student will be asked to study the physical properties of minerals and become familiar with some 100 different minerals. Take home problems will be given each week.

8.

GEOLOGY N-232 (222)  
OPTICAL MINERALOGY (3 credits)

Professor: A.N. Deland

Description: The study of minerals under the polarizing microscope. Identification of minerals in thin sections and in oil immersion. Lectures and Laboratory.

Texts: "Optical Mineralogy" by Kerr, Paul F., McGraw-Hill, 3rd edition (1959).  
(used in the labs)

"Mineral Optics, Principles and Techniques" by Phillips, Wm. R., Freeman (1971).  
(for theory)

Assignments & Grading: 20% class tests and assignments  
40% lab assignments and lab tests  
40% final exam

Prerequisite: Geology N-231

Comments: The optical properties of non-opaque minerals are studied in the lectures and in the laboratories. In the labs, identification of minerals is done under the microscope - first by determining the index or indices of refraction and then using the other optical properties.

9.

GEOLOGY N-245  
EXPLORATION GEOLOGY (3 credits)

Staff

Description: Two week field school in May right after final exams. The student is introduced to surveying, and geological and geophysical mapping methods.

Text: T.B.A.

Assignments & Grading: T.B.A.

Prerequisites: Geology N-215 and N-231 or approval of the department.

GEOLOGY N-322 (424)  
STRATIGRAPHY (3 credits)

Professor: K.K. Mukherji

Description: Sedimentary rocks, diagenetic changes; sedimentary facies; introduction to stratigraphic column and stratigraphic principles. Lectures and laboratory. One field trip around Montreal.

Text: T.B.A.

Assignments & Grading: T.B.A.

Prerequisite: Geology N-420

GEOLOGY N-323 (425)  
HISTORICAL GEOLOGY (3 credits)

Professor: H.S. de Romer

Description: Principles of historical geology and geochronology, evolution of major animal groups from Precambrian time to Recent including the evolution of man; geological evolution of North America; natural resources associated with sedimentary rocks. Lectures only.

Note: Students who have credits for Geology N-321, or the equivalent may not take this course for credit.

Text: T.B.A.

Assignments & Grading: Review questions  
50% class tests  
50% final exam

Prerequisite: None

GEOLOGY N-333  
PETROLOGY (6 credits)

Professor: A.N. Deland

Description: The identification and description of hand specimens of sedimentary, igneous, and metamorphic rocks. Rock associations and methods of classifying rocks. Lectures and laboratory.

Text: "Textbook of Lithology" by K.C. Jackson  
"Petrology" by Huang

Assignments & Grading: 50% class tests, assignment and final exam  
50% lab tests and lab reports

Prerequisite: Geology N231

Comments: One or two field trips will be run in the fall

GEOLOGY N-335  
SEDIMENTARY PETROLOGY (3 credits)

Professor: K.K. Mukherji

Description: The occurrence and formation of sedimentary rocks. Laboratory includes a brief survey of techniques applied to unconsolidated sediments, but particular emphasis is placed on the microscopic examination of sedimentary rocks. Lectures and laboratory.

Text: T.B.A.

Assignments & Grading: T.B.A.

Prerequisites: Geology N333, N232 (may be taken concurrently)

Prerequisite:

GEOLOGY N-338  
MINERALOGY II (3 credits)

Professor: A.N. Deland

Description: Point and translational symmetry, point groups, space groups, interpretation of Space Group tables, elements of crystal chemistry, chemistry and phase relations of important rock forming minerals. Stereographic projections of crystal data, the Universal Stage and powder diffractometry in identifying minerals are subjects stressed in labs. Lectures and laboratory.

Text: "Crystallography and Crystal Chemistry" by F.D. Bloss  
"An introduction to the rock-forming minerals" by Deer, Howie & Zussman.

Assignments & Grading: 60% class tests, assignments and final exam  
40% lab tests, lab assignments

Prerequisite: Geology N231

GEOLOGY N-342 (426)  
IGNEOUS AND METAMORPHIC PETROLOGY (6 credits)

Professors: A.N. Deland  
J.T. Jenkins

Description: Principles of physical chemistry applied to minerals and rocks; study of phase diagrams; the origin, formation, association of igneous and metamorphic rocks. Lectures and laboratory.

Text: "Petrology of Igneous and Metamorphic Rocks" by Hyndman, D.W., McGraw-Hill (1972). The book has an excellent bibliography and discusses the preferred origins of igneous and metamorphic rocks as related to the concept of plate tectonics.

"The Interpretation of Geological Phase Diagrams", by E.G. Ehlers

Assignments & Grading: 30% lab assignments and lab tests  
30% final exam  
15% class tests and mid term exam  
25% class assignments, field trips, field trip reports

Prerequisites: Geology N-215, N-231, N-232  
Although Physical Chemistry (Chemistry N241.3) is not a prerequisite, the course is strongly recommended.

Comments: The grading method is not definite and will be determined during the first week of classes. Students will be asked to decide if they want a final exam or not. One field trip will be run in the fall and special field projects may be assigned.

16.

GEOLOGY N-346  
STRUCTURAL GEOLOGY I (3 credits)

Professor: H.S. de Romer

Description: Folds and mesostructures and their qualitative and quantitative evaluation. Physical properties of rocks and their behaviour. Several field trips to the Appalachian area. Lectures and laboratory.

Text: "Structural Geology" by M.P. Billings.

Assignments & Grading: 45% informal lectures, class tests and final exam  
40% lab assignments and lab tests  
10% field trips, field trip reports

Prerequisite: Geology N-215 previously or concurrently.

17.

GEOLOGY N-349 (429)  
TECTONICS (3 credits)

Professor: S. Kumarapeli

Description: Evolution of megastructures of the earth; orogeny; tectonic patterns and hypotheses, referring particularly to the Appalachian orogen, emplacement of plutons. Lectures and laboratory.

Text: T.B.A.

Assignments & Grading: T.B.A.

Prerequisite: Geology N-346

NOT OFFERED IN 1976-77

GEOLOGY N-347  
STRUCTURAL ANALYSIS (3 credits)

Professor: H.S. de Romer

Professor: A.R. Deland  
M.J. Jenkins

Description: Non-tectonic structures; primary and secondary structures associated with sedimentary, igneous and metamorphic rocks; faults; evaluation of folds and fractures on geological maps. Lectures and laboratory.

Note: Students who have credits for N-351, 348 or 421 or the equivalent may not take this course for credit.

Text: T.B.A.

Assignments & Grading: T.B.A.

Assignments: 30% class assignments and lab notes

Prerequisite: Geology N-346

15% class notes and mid term exam  
35% class assignments, field trips, field trip reports

Prerequisites: Geology N-313, N-323, N-327  
Although Physical Geography (Geology N-327) is not a prerequisite, this course is strongly recommended.

Comments: The grading system is not defined but will be determined during the first week of classes. Students will be asked to decide if they want a final exam or not. The field trip will be run in the fall and special field projects may be assigned.

20.  
GEOLOGY N-352 (422)  
PHOTOGEOLOGY (3 credits)

Professor: H.S. de Romer

Description: Scope and purpose of photo-interpretation; geometry of aerial photographs and basic applied photogrammetry; geological interpretation, both qualitative and quantitative, of aerial photographs from Canada and other countries; techniques used in the base map preparation with and without control points; exercises in photogeological mapping using stereoscopes and plotters. Lectures and laboratory.

Text: "Aerial Photographs in Geologic Interpretation and Mapping" by R.G. Ray

Assignments & Grading  
40% informal lectures, class tests and final exam  
55% lab assignments and lab tests  
5% visits to commercial firms

Prerequisite: Geology N-346 or permission of the Department

21.  
GEOLOGY N-353 (423)  
FIELD GEOLOGY (3 credits)

Staff

Description: Two week field school in May after the 2nd year final examination period. Working in groups of two, students will map an area in the Appalachians, prepare sections and write a geological report. Group study of important outcrops and quarries in the Eastern Townships and south of the border. Students are expected to pay a minimum amount of their room and board.

Text: T.B.A.

Assignments & Grading: T.B.A.

Prerequisite: Geology N-333 and N-346, or permission of the department.

GEOLOGY N-370  
ANALYTICAL METHODS IN GEOCHEMISTRY (4 credits)

Professor: J.G. Dick

Description: Chemical equilibrium as applied to volumetric and gravimetric procedures: general theory of volumetric titrations; titration curves: application of general titration theory to neutralization precipitation, complexation oxidation-reduction and non-aqueous solvent titrations; theory of potentiometry and potentiometric titrations; theory of gravimetric analysis; methods of separation by chemical and physical means; electrogravimetry and electrolytic separations; absorptiometric theory and absorptiometric methods of analysis. Analyses of major and minor components of geological material. Lectures and laboratory.

Text: "Analytical Chemistry" by J.G. Dick

Assignments & Grading: T.B.A.

Prerequisites: CEGEP Chemistry 201; CEGEP Physics 301; CEGEP Mathematics 103 and 203; or equivalent courses.

GEOLOGY N-420 (223)  
PALEONTOLOGY (3 credits)

Professor: K.K. Mukherji

Description: A study of the evolution of plants, invertebrates and vertebrates in time and space, the fossil record; preservation, identification and classification of fossils; methods and techniques. Lectures and laboratory.

Text: T.B.A.

Assignments & Grading: T.B.A.

Prerequisite: None

GEOLOGY N-421 (430)  
GEOLOGY OF CANADA (3 credits)

Professor: D. McDougall

Description: The study of the geology, physical features and mineral resources of the five main natural regions of Canada. A number of selected areas will be examined in detail. Lectures only.

Text: T.B.A.

Assignments & Grading:

Prerequisites: Geology N-215, N-322 and N-333

Exams: Two written examinations, one at the end of each term.

Assignments & Grading:

Prerequisites: CHEM Chemistry 221, MATH Physics 111, other Mathematics 431 or 432, a reading knowledge of French

GEOLOGY N-445  
X-RAY CRYSTALLOGRAPHY (3 credits)

Professor: J.T. Jenkins

Description: The nature of X-rays, diffraction, the reciprocal lattice, powder diffractometer, powder cameras, single crystal methods. Laboratory work will stress the techniques of powder diffractometry and Precession photography. Lectures and laboratory.

Text: T.B.A.

Assignments & Grading:

Prerequisite: Geology N-338

Assignments & Grading: One written examination at the end of each term. Laboratory work will be graded on the basis of individual assignments and the final examination.

GEOLOGY N-455  
ORE DEPOSITS (3 credits)

Professor: P. Sassano

Description: An introduction to geological and mineralogical features and genesis of selected types of metallic and non-metallic ore deposits. Identification of ore minerals in hand specimen and under the microscope, an introduction to textures of ores, a study of a few economic mineral deposits in the field. Lectures and laboratory.

Text: T.B.A.

Assignments & Grading: T.B.A.

Prerequisites: Geology N-322 and N-333

GEOLOGY N-456  
REGIONAL ECONOMIC GEOLOGY (3 credits)

Professor: S. Kumarapeli

Description: A review of the distribution of ore deposits in time and space considered in the context of their geological environment and tectonic relations. Integrated hand specimen and microscopic examination of carefully located, representative samples from important mining camps. Lectures and laboratory.

Note: Students who have credits for Geology N460 or 440 or the equivalent may not take this course for credit.

Text: T.B.A.

Assignments & Grading: Grading system is flexible. A broad-based system depending on a final exam, lab reports and seminars has been adopted in previous years. A system will be discussed with students and agreed upon during the first week of lectures.

Prerequisite: Geology N-455

Prerequisites: Geology N-322 and N-333 or permission of the department

GEOLOGY N-461 (441)  
EXPLORATION GEOPHYSICS (3 credits)

Professor: S. Kumarapeli

Description: A brief study of the principles of magnetic, gravimetric, electric, electromagnetic and seismic methods of exploration; interpretation of geophysical data; organization of exploration programmes; selected case histories. Lectures and laboratory.

Text: T.B.A.

Assignments & Grading: Grading system is flexible. A system will be discussed with students and agreed upon during the first week of lectures. In the 1974-1975 session, the grading system was as follows:

60% three class tests  
30% lab reports  
10% assigned problems

Prerequisites: Geology N-215, N-231 or permission of the Department

GEOLOGY N-462 (442)  
EXPLORATION GEOCHEMISTRY (3 credits)

Professor: S. Kumarapeli

Description: Basic principles; primary and secondary dispersion processes and their significance in geochemical exploration; field and analytical techniques (one field excursion early in the fall term); interpretation of geochemical data; organization of exploration programmes; selected case histories. Lectures and laboratory.

Text: "Introduction to Exploration Geochemistry" Levinson, A.A. (author)

Assignments & Grading: Grading system is flexible. A system will be discussed with students and agreed upon during the first week of lectures. In 1973-1974 session the grading system as follows:

40% class tests and final exam  
30% oral presentations on assigned topics  
20% lab assignments and lab tests  
10% field trips, field trip reports

Prerequisites: Geology N-215 and N-231 or permission of the Department

GEOLOGY N-461 (4 credits)

GEOLOGY N-475

ENGINEERING GEOLOGY (3 credits)

Professor: D. McDougall

GEOL 461 N-461 (4 credits)  
GEOL 475 N-475 (3 credits)

EXPLORATION GEOGRAPHY (3 credits)

Description: Engineering properties of rocks and soils. Landslides, ground water, frost action and permanently frozen ground. Application of geology to engineering problems - concrete petrology, tunnels, slope control, foundations, roads, airports, dams and reservoirs. One term paper to be prepared. Lectures and laboratory. The laboratory period will include field trips, engineering geology case histories, and feasibility study of engineering geology problems.

Text: T.B.A.

Assignments & Grading: T.B.A.

Prerequisites: Geology N-215 (Geology N-346, N-353 recommended)